IN THE SPECIFICATION

Please amend the specification in the below paragraphs as given below.

[0002] A key feature of a video server is its ability to generate streams of video at a precise bit rate. This is critical for compliance with the ~~MPEG~~ Motion Picture Experts Group (MPEG) standard. A secondary goal for a video server is of-course, a low cost of its components. There is a conflict between these two goals, since cheaper components tend to have higher drift. This is particularly true of components such as crystals. Earlier video servers that do not utilize this invention required expensive, highly stable crystal oscillators to be included in their design.

[0013] One feature of the invention is that by careful partitioning of the processes which constitute a video server system onto the individual processors of a Symmetric Multi-Processing (SMP) system, the need for specialized hardware or Operating System Software (OS) is mitigated.

[0015] FIG. 1 shows the software architecture for a Linux implementation of the present invention (other operating systems may be used). The figure shows the foundation hardware to be Intel MultiProcessor Specification compliant hardware 120, running an SMP Linux Operating System. The kernels 106 and 116 are ~~is~~ modified to allow Central Processing Unit (CPU) ~~CPU~~ binding (processes can be locked onto specific processors). The first processor 102 runs the administrative processes 104 and the video data retrieval process. The second processor 112 runs software 114 that drives the video data out at a critically controlled rate. Since the data streaming has the highest real time demands, interruptions of this process can be minimized by assigning all interrupts (other than Gigabit Ethernet 122) to the other processor 102.

[0016] FIG. 2 shows the software architecture for the uni-processor Linux implementation. Again the foundation hardware is Intel Multi-Processor Specification compliant hardware 204. The video server tasks are divided up the same way; the first processor 202 runs the administrative processes 206 and the video data retrieval

process and the second processor 212 runs software 214 that drives the video data out at a critically controlled rate. The difference being that the second processor 212 is not running Linux 208 and consequently the application 214 will not be interrupted by the operating system 208. This allows the dedicated streaming engine software 214 to have fine control over the CPU1 cache hardware 212 and to allow the Stream Engine 214 to achieve maximum performance by executing [[it's]] its code entirely from within the processors L1+2 cache.

[0017] Since the Streaming Engine 214 is running without an OS support, the ~~Kernel's IP stack~~ IP stack 210 of the Kernel 208 will no longer take care of network housekeeping (~~ICMP~~ Internet Control Message Protocol, or "ICMP"). To facilitate this, it is proposed that a `Gigabit Ethernet virtual driver` 220 be implemented under the Linux kernel 212 on CPU0 202. This would pass any non-streaming packets back and forth between the Streaming Engine code 214 running on CPU1 212 and the kernel 208 on CPU0 202. This allows ping and other ICMP messages to be supported without the need to implement them in the Streaming Engine code 214.

[0018] Intel has published a standard for MultiProcessor systems known as "MultiProcessor Specification" version 1.4 1997, which is incorporated herein by reference in its entirety and may be accessed at ~~http://developer.intel.com/design/pro/datashts/2420-1606.pdf~~ http://developer.intel.com/design/pro/datashts/2420 1606.pdf. This specification describes an architecture where memory and peripherals are symmetrically shared between multiple processors. Machines are readily available, which conform to this standard, in the form of multi-processor ~~PCs~~ Personal Computers (PCs). The intention [[or]] of the MultiProcessor Standard is for a single copy of the operating system and applications to run on all/any processors in the system. This architecture is known as Symmetric MultiProcessing.

[0020] Video Servers are required to output data with strict conformance to industry standards. These standards require data packets to be output with deadlines expressed in microseconds. The demands of the output stage, in turn place requirements on the retrieval of data from the disk drives. Such requirements require the software to be Asymmetric, i.e. dedicated software runs on dedicated processors. By careful design and consideration of these needs, this patent describes how a ~~COTS~~ commercial off-

the-shelf (COTS) PC and COTS software can be utilized to create a platform that provides real time performance required for a Video on demand server.

[0028] The output bit-rate of the DVS6000 is held to within 6 ppm in order to meet the buffer requirements of the MPEG sink. The limiting factor is buffer overflow. Bit-rate of 15 is required for ~~HDTV~~ High Definition Television (HDTV), we are concerned, only with bit-rates up to 4 Mbps. For a 2-hour movie, we need a clock reference accurate to within 6.37 ppm. See Appendix A. This means that the typical output can range from 3.374988 to 3.750012 Mbps.

[0031] These measurements were taken using a Qsol machine to confirm that the error will be within 5 ms. The time servers we were referencing have three switches and a router between them. The original reference is a Stratum 1 Internet source. It is imperative that the quality of the original time source be good and that the network between the servers be good. Since NTP uses round trip ~~UDP~~ User Datagram Protocol (UDP) packets to acquire time samples, poor network communications increases the error in the time correction. It is assumed that DIVA will access to a stratum 1 or, optionally, stratum 2 timeserver with guaranteed sub millisecond to millisecond accuracy is provided.

[0036] The stability of the local clock is based on the characteristics of the 14 MHz crystal. See **FIG. 9** for its drift with temperature. Each line corresponds to a particular angle of cut of the crystal. ~~Wee assume~~ Worst case is assumed.

[0037] In summary the 14 MHz crystal will change by 1 ppm for each degree C. change in temperature. This will result in a change of 1 ppm per degree C. in the GHZ CLOCK. **FIG. 10** shows actual results measured on a qsol machine. They show a 35 degree C. change 1002 in external temperature caused a 10 ppm change in crystal frequency. This indicates that the crystal is somewhat insulated from external temperature changes. Also indicated in these results is that variations in the 120 VAC supply do not significantly affect the crystal frequency 1004.

[0044] In **FIG. 11** you can see the point at which NTP corrects the system clock 1102. These corrections do not affect the Pentium's Time Stamp Counter 1104 (TSC) which is directly driven from the crystal 1106, consequently, the Media Server Rate Controller 1108 will continuously measure the TSC frequency and correct the value of Ticks per

Second used to correctly space the transmitted frames.

[0045] The Media Server 1108 attaches an expected transmission time to each frame that is queued up and ready to transmit. The difference between consecutive frames is the value Ticks_Per_Frame. The Media Server's rate generator 1110 monitors the TSC 1104 and tries to transmit the packets at the correct time.

[0047] Since it is important to have an accurate measurement of the TSC frequency before the server can deliver conformant streams, in one embodiment the TSC 1104 be calibrated during the factory testing. The initial calibration would be over a one-hour period. ~~I would~~ It would be essential to ensure that a suitable timeserver be available during this initial calibration. This optionally consists of a T1 connection to the Public Internet timeservers. The calibration value is held on the disk in the writable partition.

[0053] The desired value of k in the equation can be estimated from the typical sample data in **FIG.** [[**10**]] **12**.

[0054] The solid line 1202 is the actual crystal frequencies measured at 3600-second intervals. The dotted line 1204 is a moving average. The change 1206 between points 1,130,412,954 and 1,130,412,954 is 1274 or 1.274 ppm. The actual amount we would like to change is indicated by the change in the moving average line at this point. The value of k should be 0.25. This value should be confirmed by experimentation.